

A Comparison of Cursor-Key Arrangements (Box Versus Cross) for VDUs

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Abstract

On video display terminals, cursor-positioning keys (usually four in number) are generally arranged in a box (rectangular) arrangement, or in a cross (cruciform) arrangement. Performance of 32 inexperienced subjects and 10 experienced subjects on the box arrangement was measured. Measures included time to perform the task, number of extra moves taken, the number of non-cursor keys struck, and the time to locate the first cursor key in a move sequence. The inexperienced group performed better on the cross arrangement for all measures except the number of noncursor keys struck. The experienced group showed no differences in the performance measures with the exception of the greater number of extra moves on the box arrangements. Test results showed that subjects performed generally better with the cross cursor arrangement.

1. Introduction

Several layouts of cursor-positioning keys have been used by manufacturers of video display terminals. The most popular layouts are the box arrangement and the cross or cruciform arrangement.

An informal survey of 23 European manufacturers of video display terminals found that 14 used the cross, 5 used box, 2 used a straight row layout and 2 used contextual cursors. Intuitively, the cross arrangement appears to be the better layout since the location of the keys is a cue to the direction of movement.

The purposes of the present study were to determine:

1. Do people show a difference in performance and/or preference between the two arrangements.
2. Would terminal users experienced on the box arrangement have difficulty in transferring to the cross layout?

1.1. Keyboards

The arrangements of the cursor keys on the keyboards used in this study are shown in Figures 1 and 2. The keyboards were otherwise mechanically and electronically identical. The cursor keys were 'Typamatic', with a 0.5-second delay before onset of Typamatic mode and a repetition rate of 10 characters per second.

FIGURE 1. *Box arrangement.*

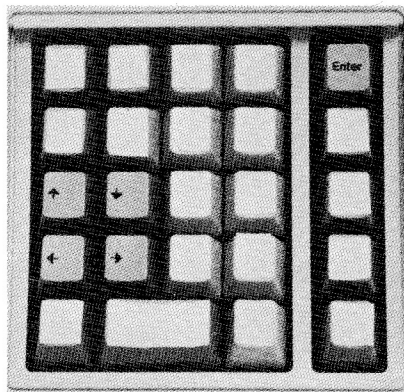
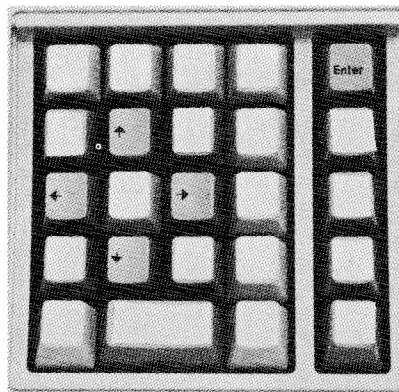


FIGURE 2. *Cross arrangement.*



2. Procedure

Thirty-two subjects with little or no experience in cursor-positioning tasks participated in the first phase of this experiment. The second phase employed ten subjects experienced in the use of the box arrangement.

A subject's task began when the system displayed an 'S' (Start) and a '#' (target) on the terminal screen. A sample display can be seen in Figure 3.

The cursor was prepositioned at the start location. The subject would then key in single strokes, or use Typamatic (continuous) mode, to move the cursor toward the target. When the cursor reached the target, the trial was concluded.

To begin the next trial, the operator keyed ENTER, which brought up a new display with S and # in new positions. Each session consisted of 120 such trials. The trials presented to the operator were selected from a 120-trial pool in a random sequence without duplication.

The length of cursor movement was divided into three categories as shown in Table 1. Each trial required one of the following eight types of cursor movement.

right only	right and up
left only	right and down
up only	left and up
down only	left and down

The 120 trials in a session consisted of 5 trials from each category of length for each of the 8 types of movements. During each session, the minimum number of cursor moves (characters or lines) required to complete the 120 trials was 3422.

FIGURE 3. Sample display screen of cursor-positioning tasks.

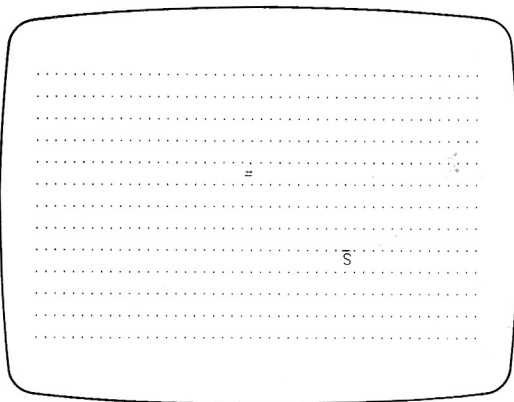


TABLE I. Intervals of cursor travel.

Direction of cursor movement	Intervals of cursor travel		
	Short	Intermediate	Long
Right or left (characters)	11-15	21-25	36-40
up or down (lines)	4-8	12-16	18-22

The mean number of moves for short, intermediate, and long movements were 14.28, 27.75 and 43.50 respectively. The mean number of moves for all trials was 28.51.

3. Experimental Design

Each subject completed four sessions (two sessions on each keyboard) which were presented in a 2×2 Latin-square design.

The stimulus presentation, recording of keystrokes, and their associated time of occurrence were controlled by a computer program.

4. Results

The four dependent variables were time to complete a trial, the time from the presentation of the stimulus screen until the first keystroke, the number of extra or superfluous moves made while manoeuvring the cursor to the target, and the percentage of noncursor keys accidentally struck (number of noncursor keys divided by the number of required direction changes multiplied by 100.)

4.1. Inexperienced Subjects

An analysis of variance was computed for the four dependent variables for each of the 24 combinations of lengths and directions (Simons and Clauer, 1978). Since the results were essentially the same for all of the combinations, only the statistics for the combined data are presented here. Table 2 shows the means, the 95% confidence interval of the differences between the means, and the probabilities of the differences between the means being due to chance.

TABLE 2. *Performance results using inexperienced subjects.*

Dependent variables	Cursor arrangement		95% interval	Probability
	Box	Cross		
Time per trial (seconds)	6.15	5.91	± 0.14	0.002
ENTER to 1st move (seconds)	1.51	1.37	± 0.08	0.008
Extra moves per trial	0.83	0.70	± 0.09	0.003
Percent of noncursor keys	0.25	0.49	± 0.16	0.005

All of the measures show significance beyond the 0.05 level of confidence. The performance differences are all in favour of the cross arrangement with the exception of accidental depression of noncursor keys.

A total of 19 subjects preferred the cross arrangement, 12 preferred the box arrangement, while one subject expressed no preference.

A chi-square test of hypothesized population proportions (Bradley, 1976) was applied to the preference data and was not significant at the 0.05 level of probability.

4.2. Experienced Subjects

Table 3 shows the results for the experienced group. No significant differences were found for any of the dependent variables with the exception of extra moves. There were a greater number of extra moves with the box arrangement.

TABLE 3. *Performance results using experienced subjects.*

Dependent variables	Cursor arrangement		95% confidence interval	Probability
	Box	Cross		
Time per trial (seconds)	5.30	5.27	± 0.14	N.S.*
ENTER to 1st move (seconds)	1.26	1.22	± 0.11	N.S.
Extra moves per trial	0.45	0.33	± 0.10	0.03
Percent of noncursor keys	0.20	0.27	± 0.20	N.S.

* Not significant, $p > 0.05$

Four subjects preferred the box arrangement, three preferred the cross layout, and three expressed no preference. The chi-square test was not significant at the 0.05 level of probability. Nine of the ten experienced subjects felt they would have no difficulty in switching to the cross pattern.

5. Discussion

The results indicate that the cross cursor arrangement is superior in performance measurements for inexperienced subjects. Even subjects experienced on the box arrangement performed just as well on the cross layout.

Much of the advantage for the cross cursor arrangement for the inexperienced group appears to be due to the fact that the subjects could locate the first key to be struck faster (1.37 seconds for the cross and 1.51 for the box). These findings are in agreement with the findings of Fitts *et al.* (1953) concerning stimulus-response compatibility. This advantage disappeared in the case of the experienced subjects, which might be expected from their familiarity with the box arrangement.

The inadvertent striking of noncursor keys for both the box and cross layouts was less frequent in the experienced group, reflecting their superior keying ability.

6. Conclusions

1. The cross cursor arrangement is superior in all performance measures except for the percentage of inadvertently struck noncursor keys for subjects with little or no experience in a cursor-moving task.
2. Subjects with experience on the box layout perform at least as well on the cross pattern.
3. The preference data is inconclusive.

References

- Bradley, J.V., 1976, *Probability, Decision, Statistics* (Englewood Cliffs, New Jersey: Prentice Hall).
- Fitts, P.M., Seeger, C.M. and Stewart, C.M., 1953, S-R compatibility: Spatial characteristic of stimulus and response codes. *Journal of Experimental Psychology*, **46**, 199-210.
- Simons, R.M. and Clauer, C.K., December 1978, *LATIN: A PL/1 program for the analysis of replicated latin square experimental design* (San Jose, CA: IBM Human Factors Center Report HFC-28).